II

E7.6-10263
CR-146635

DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE

Ron Jones Peggy Harwood	The General Land Office 1700 North Congress Austin, Texas 78701
Robert Finley	Bureau of Economic Geology The University of Texas at Austin Austin, Texas 78712
George Clements Larry Lodwick	Texas Parks and Wildlife Department Austin, Texas 78701
Samuel McCulloch David Murphy	Texas Water Development Board Austin, Texas 78701

MARCH 1976

TYPE II (QUARTERLY REPORT)

DECEMBER 1976 THROUGH FEBRUARY 1976

prepared for:

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

(E76-10263) DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Dec. - Feb. 1976 (Texas Univ.) 56 p HC $4.50 N76-20608
G3/43 Unclas 00263

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE		5. Report Date March 1976
		6. Performing Organization Code
7. Author(s) R. Jones, P. Harwood, R. Finley, S. McCulloch, D. Murphy, G. Clements, L. Lodwick		8. Performing Organization Report No.
9. Performing Organization Name and Address General Land Office 1700 North Congress Austin, Texas 78701	Texas Parks & Wildlife Dept. Texas Water Development Board Bureau of Economic Geology Austin, Texas 78701	10. Work Unit No.
		11. Contract or Grant No. NAS5-20986
		13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Goddard Space Flight Center Mr. Fred Gordon Code 902 Greenbelt, Maryland 20771		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The most significant contributions during the third quarter are 1) the modification of an existing software package to produce classified printer maps that are scaled and registered to U.S.G.S. 7 1/2 minute topographic maps, 2) the application of image interpretation techniques to a new, more complex area on the Texas coast, and 3) the description of the LANDSAT-based system capabilities for data acquisition, data analysis and information display.

17. Key Words Suggested by Author	18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

1.1 Scope and Purpose of Report

This progress report covers activities during the third quarter, November 25, 1975 through February 25, 1976, for LANDSAT Investigation #23790. This investigation is funded for 19 months to develop techniques in Texas state agencies for using LANDSAT data to inventory and monitor coastal resources and uses. The General Land Office (GLO) is the Texas agency coordinating this investigation. Other participating agencies are the Bureau of Economic Geology (BEG), Texas Water Development Board (TWDB), and Texas Parks and Wildlife Department (TPWD).

1.2 Summary of Work Performed

During the third reporting period most of the accomplishments have dealt with refining techniques for extracting information from LANDSAT data. Specific accomplishments for the third quarter have been 1) to modify part of the detection and mapping (DAM) package so that printer maps, scaled and registered to U.S.G.S. 7 1/2 minute topographic maps, can be generated for the ADP classification results, 2) to develop a biological verification procedure for documenting plant species that occur in marsh, 3) to apply new procedures for correlating the image interpretation line boundary map with the scaled and registered ADP display, 4) to initiate examination of a new area, test site 2, using procedures developed in test site 3, and 5) to summarize the interim

status of data acquisition, data analysis, and information display capabilities for the design of the LANDSAT-based monitoring system.

2.0 PROBLEMS

2.1 Technical Problems

No technical problems relating to image interpretation procedures were encountered during this quarter. The techniques outlined in Section 3.3 of the second quarterly report (Jones, et al., 1975) have been applied to data from test site 2 (Scene 1289 - 16261, 8 May 73) without the need for modification.

Problems encountered in the ADP classification of the LANDSAT data centered around the gathering of training statistics discussed in Section 3.1.2. In clustering a test site, several classes are produced which have large standard deviations. These classes are small (less than 1% of pixels included in training area), scattered, and usually associated with shoreline features at the land/water transition zone. Breaking such classes into their composite sub-classes to achieve tighter standard deviations has been difficult, time consuming, and generally unsatisfactory. While some sub-classes have been isolated, others have eluded detection because of their small size, and hence, remain unclassified.

Another problem involves the look-up table in the ELLTAB classifier. Programming constraints currently limit the combined table size to 12,000 words. Due to the spectral complexity of

the coastal areas, this limit is often exceeded. Solutions being explored involve either 1) program modifications to allow increasing the table size, or 2) separate classification of land and water features to reduce the size of the table needed in a given run.

2.2 Staffing Changes

Bureau of Economic Geology (BEG). Mr. Robert Baumgardner has replaced Mr. Samual Shannon as assistant to Dr. Robert Finley at the Bureau of Economic Geology. Mr. Baumgardner has a B. A. degree in zoology from the University of Texas at Austin and is currently working toward an M. A. degree in geology at this same school.

Texas Parks and Wildlife Department (TPWD). Mr. Larry Lodwick, a staff research botanist in the Parks Division of TPWD has been assigned part-time from the Austin office. Mr. Lodwick's duties include 1) assisting George Clements by designing an appropriate field approach to document plant composition within the marshes, and 2) consulting on the definition and correlation of coastal vegetation with LANDSAT marsh classes.

3.0 ACCOMPLISHMENTS

3.1 Examination of Test Site 3 (San Antonio Bay Area)

3.1.1 Area Description of Test Site 3

Test site 3 overlays parts of San Antonio and Espiritu Santo Bays (Figure 1), which contain over 16,500 acres of salt marsh located mostly along the bayward shore of Matagorda Island, including the marshes at Pass Cavallo near Port O'Connor. Characteristic salt and brackish marsh plant species include *Spartina alterniflora*, *Spartina spartinae*, *Distichlis spicata*, *Monanthochloë littoralis*, *Batis maritima*, and *Borrichia frutescens*.

Approximately 12,800 acres of brackish to fresh marsh is found in the upper reaches of San Antonio Bay, above Hynes Bay and Mission Lake on the delta of the Guadalupe River. Characteristic plants in these marshes include *Phragmites communnis*, *Spartina patens*, *Spartina spartinae*, and *Juncus* spp.

The climate of this portion of the Texas Gulf Coast is subhumid, warm temperate. Average annual rainfall is 34 inches and the temperature ranges from about 20°F to 90°F or more during the summer months. Winters are usually very mild, having an average of only seven days of freezing or below freezing weather per annum (Texas Parks and Wildlife Department, 1975).

The area is relatively rural, having only two major industrial plants in the county (such as Union Carbide near Mission Lake on the Austwell quadrangle) and a few small communities characterized by widely spaced buildings and large, grass-covered lots. These small communities, such as Austwell (population 284) and Port O'Connor (population 350) are devoted to farming, or sport and

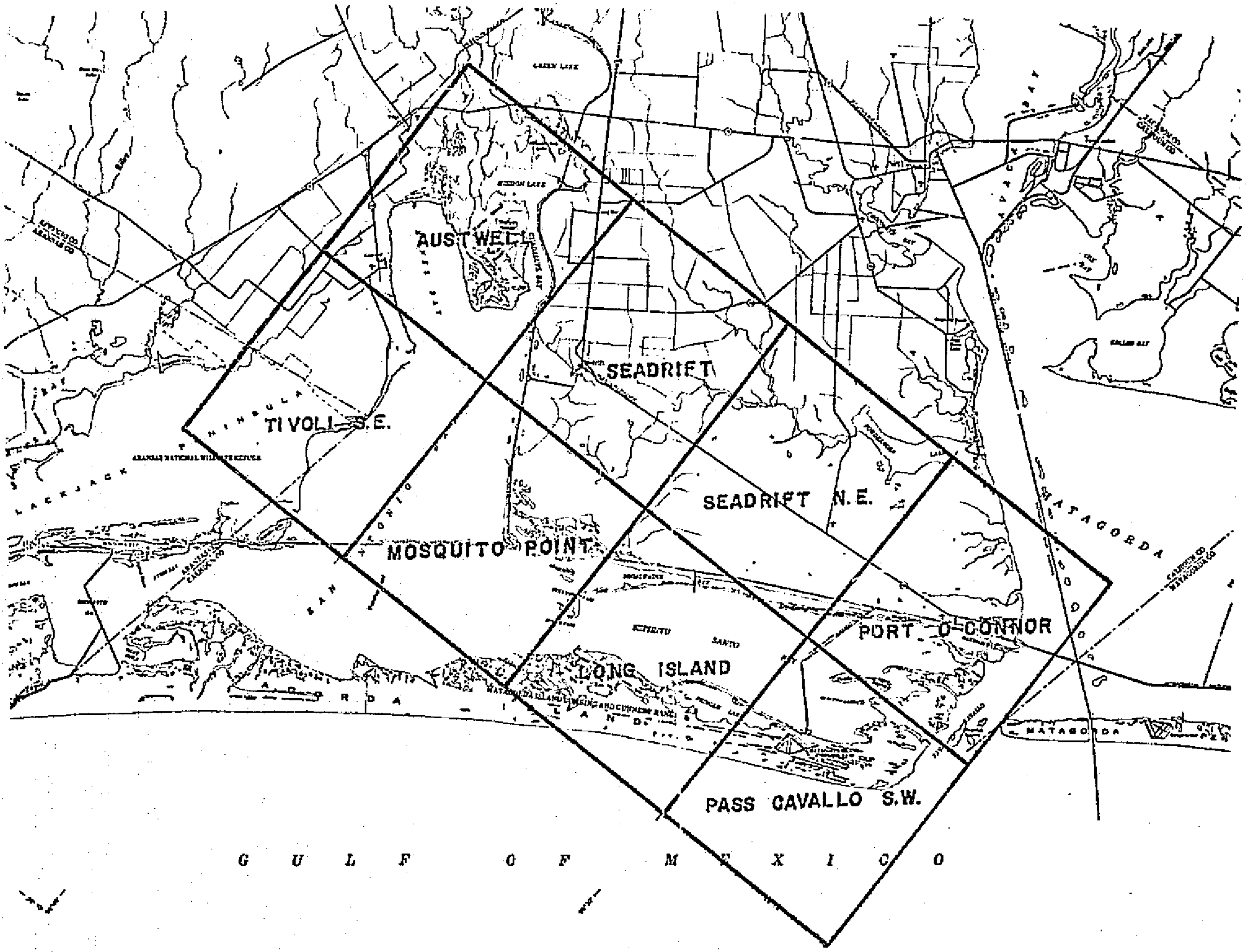

Figure 1. U.S.G.S. 7 1/2 minute topographic maps overlaying test site 3, San Antonio Bay area.

commercial fishing (The Dallas Morning News, 1972). The acreage of rangeland devoted to beef production is over twice that devoted to croplands in the area. The two major crops are rice and sorghum. Minor crops include cotton, soybeans, flax and sunflowers. The majority of the rangeland is unimproved, consisting of mixed native grasses, shrubs, and trees (Gilbert Heideman, County Agricultural Extension Agent, personal communication, 1976).

The areas of emphasis within test site 3 are those with the most extensive wetlands, corresponding to the Austwell, Mosquito Point, Port O'Connor and Pass Cavallo S. W. quadrangles (Figures 1 and 2). Elevations of 5 feet or less above Mean Sea Level are generally encountered, with the exception of the Matagorda Island dunes and barrier flat, and the rangeland northwest of Port O'Connor.

The central feature of the Austwell quadrangle, the Guadalupe River delta consists of deltaic muds and sands and associated levee and crevasse splay deposits of mud, silt and sand (McGowen, J. M., et al, 1976). Marshes and grasslands with scattered shrubs are present. The river and its distributaries are bordered by thin belts of woodland which are detectable on LANDSAT imagery by the human interpreter, more on the basis of form than radiance.

The areas at the junction of San Antonio and Espiritu Santo Bays, shown on the Mosquito Point quadrangle, include salt marshes, tidal flats with sparse vegetation and dredge spoil from the Victoria Barge Canal and Gulf Intracoastal Waterway. Vegetated spoil is distinguishable on the basis of form and position, in addition to radiance, as is also the case for beaches vs. barren spoil.

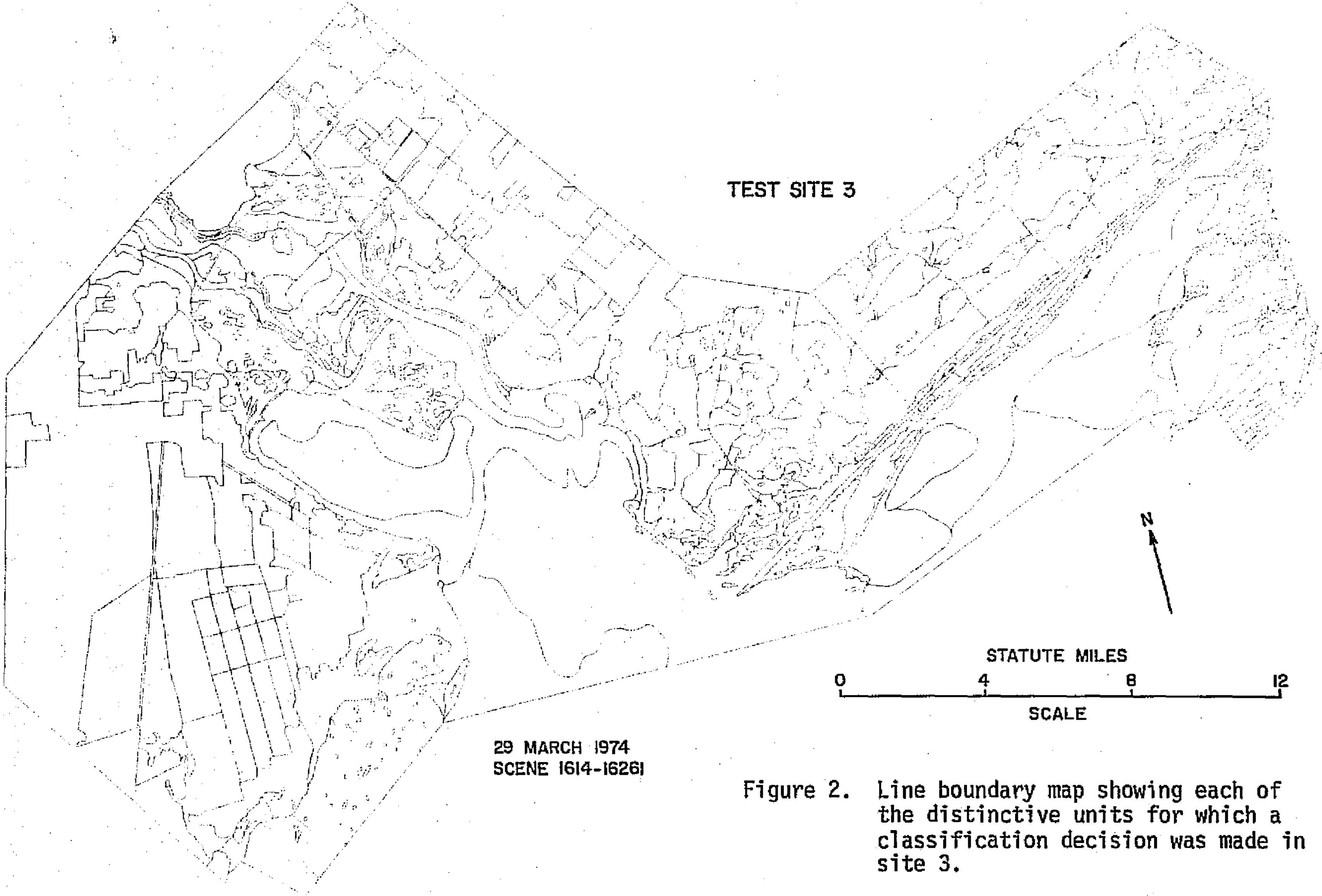

Figure 2. Line boundary map showing each of the distinctive units for which a classification decision was made in site 3.

The flood-tidal delta marshes of the Pass Cavallo area are the most extensive salt marshes in test site 3 and are the most similar in physiography to the well known low marshes of the southeastern United States. The dominant species are *Spartina alterniflora*, *Batis maritima* and *Salicornia* spp. in the low areas most subject to tidal inundation. Black mangrove (*Avicennia germinans*) is also present but not in stands extensive enough to be detected on LANDSAT imagery.

Cropland in site 3 is concentrated over Pleistocene interdistributary mud with distributary silts and sands (McGowen, J. H. et al., 1976). Pleistocene marine deltaic sand, barrier strandplain sands and sheet sands are not favorable for crops and therefore such areas are used as range-pasture lands. The latter include Ingleside sands southwest of Port O'Connor and south-southwest of Austwell, which appear mottled on LANDSAT imagery due to accumulation of mud and organic material in isolated low depressions.

3.1.2 ADP Reclassification of Test Site 3

During this quarter, test site 3 was reclassified for two reasons: (1) the capability of producing registered printer maps is now available, and (2) a uniform, automatic data processing (ADP) classification for all areas within the site is desirable for correlation purposes. Previously, each area had been classified separately. The new classification used ISOCLS to produce

the class statistics and ELLTAB to classify the data.

The use of ISOCLS to develop the class statistics is the most critical part of the classification procedure, since the statistics determine the sensitivity of the classification. The initial ISOCLS run was made using the following parameters:

(1) one sixth of the area, every third line and every second sample, was clustered;

(2) the minimum number of pixels per class, NMIN, was set at 1% of the pixels clustered;

(3) the number of iterations, ISTOP, was set at 10;

(4) the maximum number of clusters, MAXCLS, was set at 30;

(5) the maximum allowable standard deviation, STDMAX, was set at 3.0; and

(6) clusters separated by a distance of less than DLMIN=2.0 were combined.

With these input parameters, ISOCLS produced 19 classes, three of which were small, scattered classes with large standard deviations. Problems working with such classes are discussed in Section 2.0. The statistics for the classes were used by ELLTAB to classify the areas of interest within the site. A recently modified version of DAM, the Detection and Mapping Package (for water) developed

by NASA, Johnson Space Center (JSC), was then used to produce printer maps scaled and registered to 7 1/2 minute U.S.G.S. quadrangle sheets (Appendix A). The changes to DAM consisted of the modification of one program, MAPRNT, and the replacement of one subroutine, READ2N, by another, RDCLAS. Some of the 19 classes were combined in printing the registered maps in order to facilitate correlation with catagories on other map data, such as the BEG Coastal Atlas series.

3.1.3 Correlation of ADP Spectral Classes with Image Interpretation Results

Enlargement of portions of the 1:125,000 image interpretation line boundary map (Figure 2) to the 1:24,000 scale of the automatic data processing (ADP) display has greatly aided correlation of the two products. The enlargement is made from the line boundary map scribe sheet, that is projected on a photographic matte film which will accept ink or pencil annotation. The alphabetic abbreviation for each class on the classification scheme is added for each of the delineated areas, and the sheet is then overlain on the quadrangle-registered, ADP display for correlation purposes (Figure 3). This correlation techniques was conceived by Mr. Bill Hupp (TWDB), and the overlay produced on equipment of the Texas State Highway Department.

Registration between the film overlay, the Austwell quadrangle, and the registered ADP display was good, though not perfect,

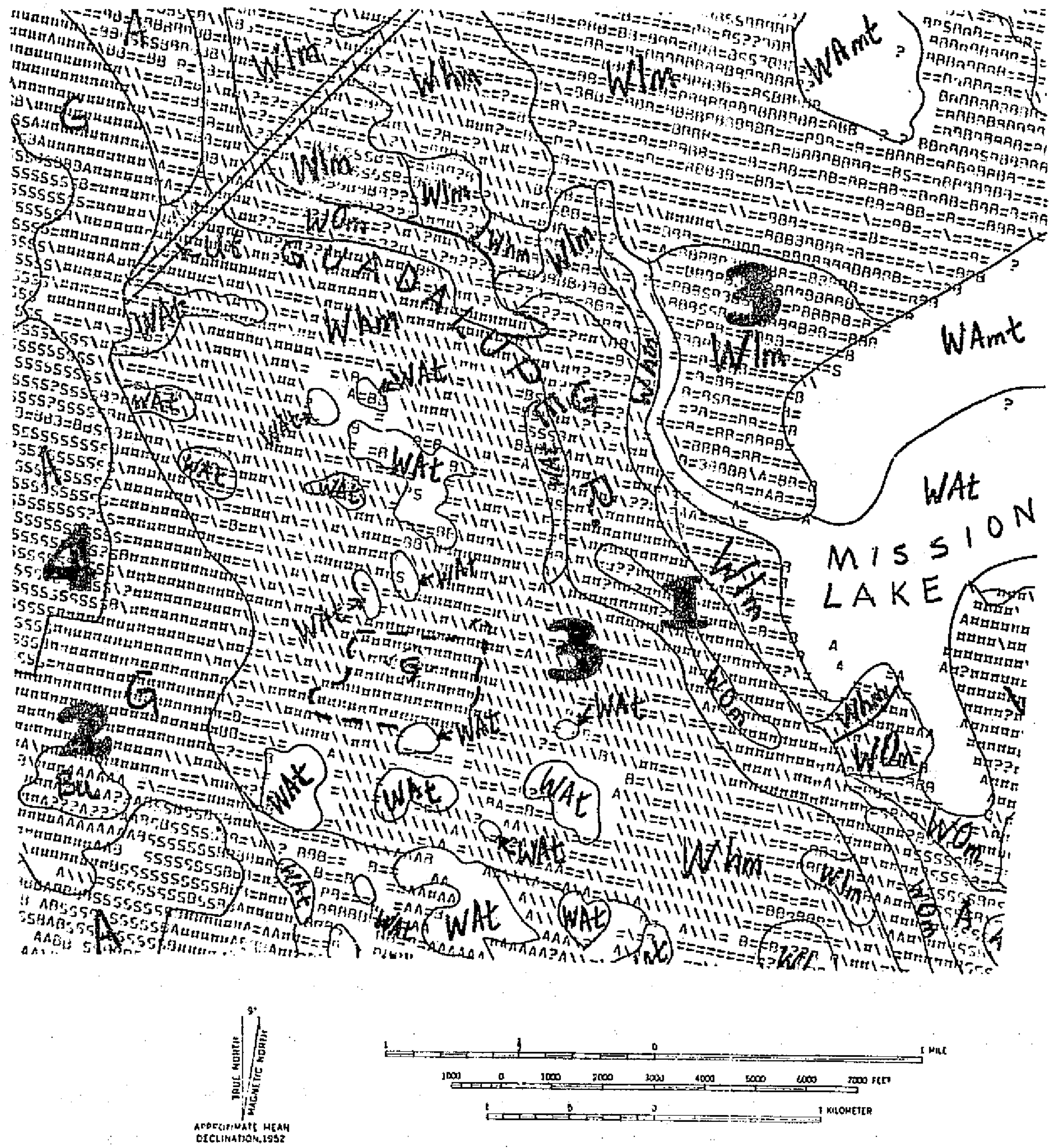

Figure 3. Correlation on part of Austwell quadrangle using an enlargement of the image interpretation line boundary map overlayed on the scaled and registered ADP display. The large numbers refer to results of the correlation process mentioned in Section 3.1.3. Hand written symbols on this working copy refer to the classification scheme: eg., Wlm=Low marsh, Whm=high marsh, A=agricultural land, G=grassland, WOm=mixed woodland, WAmt=moderately turbid water, WAt=highly turbid water, Bu=undifferentiated barren.

considering the production of the film overlay from unrectified LANDSAT data that was enlarged, first from 1:1,000,000 to 1:125,000, and then from 1:125,000 to 1:24,000. The large numbers on Figure 3 refer to the following observations that have resulted from the correlation process:

1) A narrow strip of fluvial woodlands, verified from aerial photography (Mission 300) and field work was mapped along the Guadalupe River on the image interpretation, but not on the ADP product. This class was omitted from the ADP results, possibly because the radiance was not distinctive enough and the sample of woodland too small, relative to an adjoining grassland area.

2) A very high reflectance, barren area in a Grassland area was classified as undifferentiated barren land on the image interpretation and was verified from aerial photography, but was not delineated as a separate class on one of the earlier versions of the ADP product. This barren area was resolved with further ADP work.

3) Two ADP classes generally corresponded in location (with some other ADP classes scattered throughout) to the image interpretation classes of topographically low, wet marsh and topographically

higher, less wet marsh which grades into range-pasture grasslands. This general correspondence of one ADP class per image interpretation marsh class may make possible the discrimination of the two marsh types if this distinction is verified by field examination.

4) Correspondence between image interpretation and ADP analysis of fallow agricultural fields was excellent, since the bare mud substrate on the 29 March 1974 scene provided high radiance contrast with surrounding range-pasture grasslands.

Further qualitative comparisons of this type will be used to build a table of the types of differences and similarities between the ADP and image interpretation products revealed by detailed correlation.

3.1.4 Field Verification Approaches

Biological field verification is conducted as required by the image interpreter of the project in order to assist in correlating ADP products with imagery and also to document the marsh vegetation represented in the ADP and image interpretation marsh classes. Vegetation sampling sites are chosen within spectrally uniform areas on the ADP and image interpretation results, and then located on U.S.G.S. 7 1/2 minute topographic maps. The

field approach currently being performed uses the point intercept method (Appendix B).

Most sampling sites selected during this reporting period are normally accessible only by small boat. Due to unusually low tides during February, these areas have been inaccessible even to the smallest TPWD outboard skiffs. Thus, at this time, only a few field transects for vegetation types that were accessible by land have been accomplished.

The geologic verification procedure includes extensive use of available mapping, aircraft photography and published reports as the basis for ground truth. In addition, time histories of weather conditions have been compiled for the week ending with the date of the LANDSAT image, as an aid in interpreting each scene. Figure 4 shows wind data for the 22-30 March 74 period which includes the 29 March 74 scene of test site 3 and is based on U. S. Weather Service data taken at Victoria, Texas. As this station is some 35 miles inland from the test site the precise velocities will not apply to the coastal area, but the general onshore or offshore direction and relative duration are probably similar. Precipitation data is also being compiled and tide gauge data has been obtained from the U. S. Army Corps of Engineers, Galveston District.

The large scale photography of Missions 300 and 325, as well as the smaller scale photography for the entire Texas coastal zone, have been very useful in interpreting questionable features on the

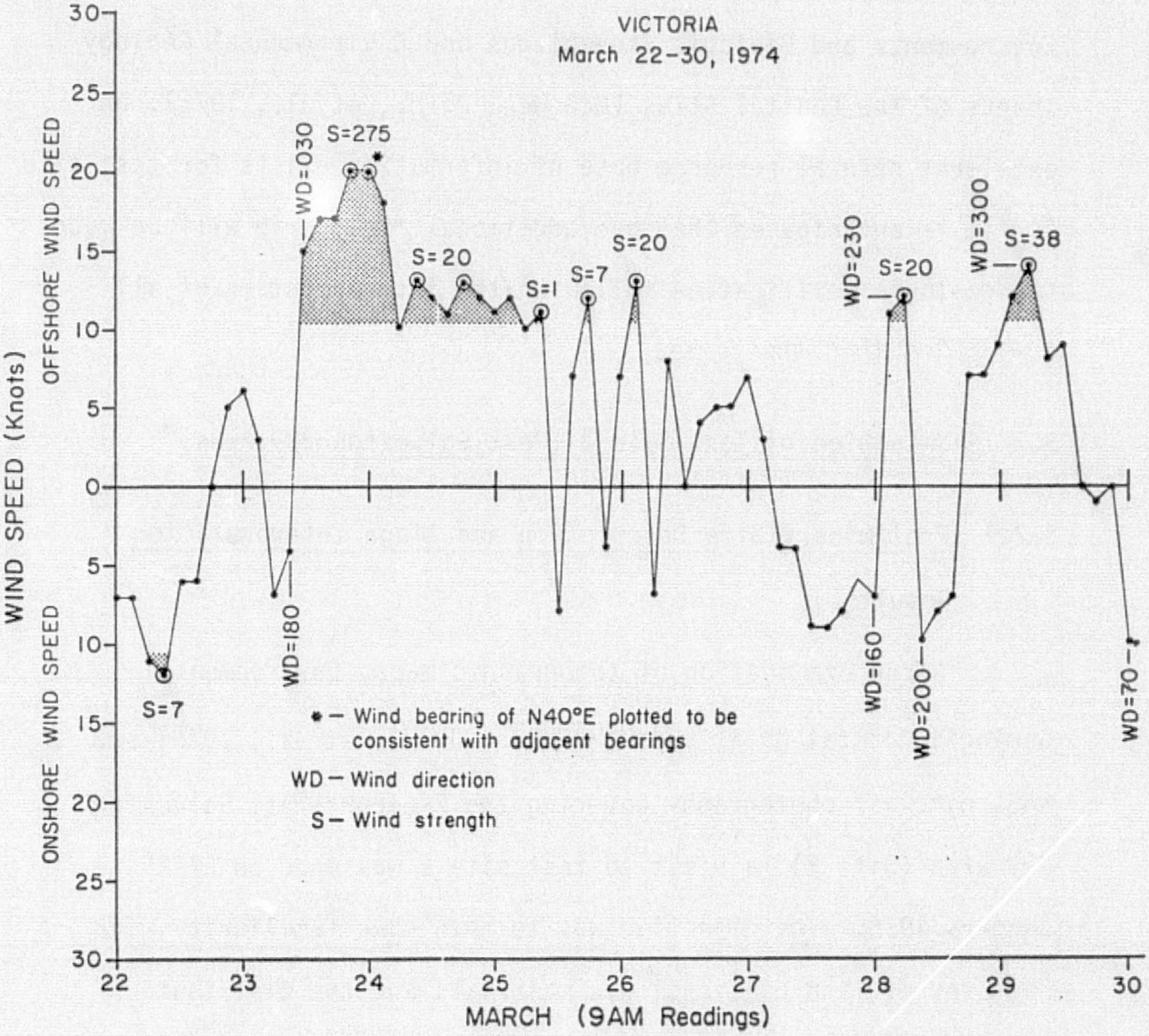

Figure 4. Wind data prior to the 29 March 1974 image shows that wind strengths were low, and therefore, water levels would not be wind influenced. Effective winds are those above 10.4 knots (12 mph), and $S=(V-10.4\ \text{knots})^2(d)$ where V=observed velocity and d=wind duration (Price, 1975). Data are plotted at 3-hour intervals, and shaded areas indicate periods of effective winds and the associated peak strength.

LANDSAT imagery. When this photography is utilized with the Environments and Biologic Assemblages and Environmental Geology sheets of the Coastal Atlas (McGowen, J. H., et al., 1976), an excellent natural resource base of information exists for test site 3. It is anticipated that one additional field trip will be made for geologic verification following the interpretation of all scenes for this test site.

3.2 Examination of Test Site 2 (West Galveston Bay Area)

3.2.1 Preliminary Site Description and Image Interpretation Results

After examination of topographic maps, Environmental Geologic Coastal Atlas maps (McGowen, J. H., et al., 1976) and NASA aircraft photography covering the Freeport-West Galveston Bay area (Site 2), a visit to test site 2 was made on 27-28 January 1976. The objective was to gain some familiarity with patterns of land use, geologic materials and the distribution and general types of vegetation prior to LANDSAT image interpretation. Test site 2, located about 60 miles northeast from test site 3, is probably the most diverse among all the test sites in that it includes:

(1) the urban areas of Freeport, Lake Jackson and Clute, as well as numerous smaller developed areas;

(2) major chemical and petroleum-production related industrial sites along with numerous smaller sites for industries serving the petrochemical complexes;

(3) the Brazosport shipping facilities;

(4) many dredged channels associated with the area's commercial activities;

(5) a system of hurricane protection dikes resulting in non-natural contrasts in vegetation type over short distances;

(6) and, extensive wetlands associated with a strand-plain type of shoreline developed on a Holocene deltaic headland (McGowen and Scott, 1975).

This complexity has resulted in the large number of individual areas delineated on the line boundary map (Figure 5), interpreted from scene 1289 - 16261, 8 May 1973. The presence of many active and abandoned stream channels, ponds, oxbow lakes and low marsh areas resulted in the delineation of numerous small units on the basis of form and texture.

3.2.2 Preliminary ADP Classification

ADP classification of test site 2 (Scene 1289-16261, 8 May 1973) was begun during this quarter, and followed the procedures described for test site 3 in the preceding progress report. DAM was used to classify water and to register the classified results to U.S.G.S. 7.5 minute topographic maps. ISOCLS was used to produce a uniform set of statistics for the site. Again, the problem

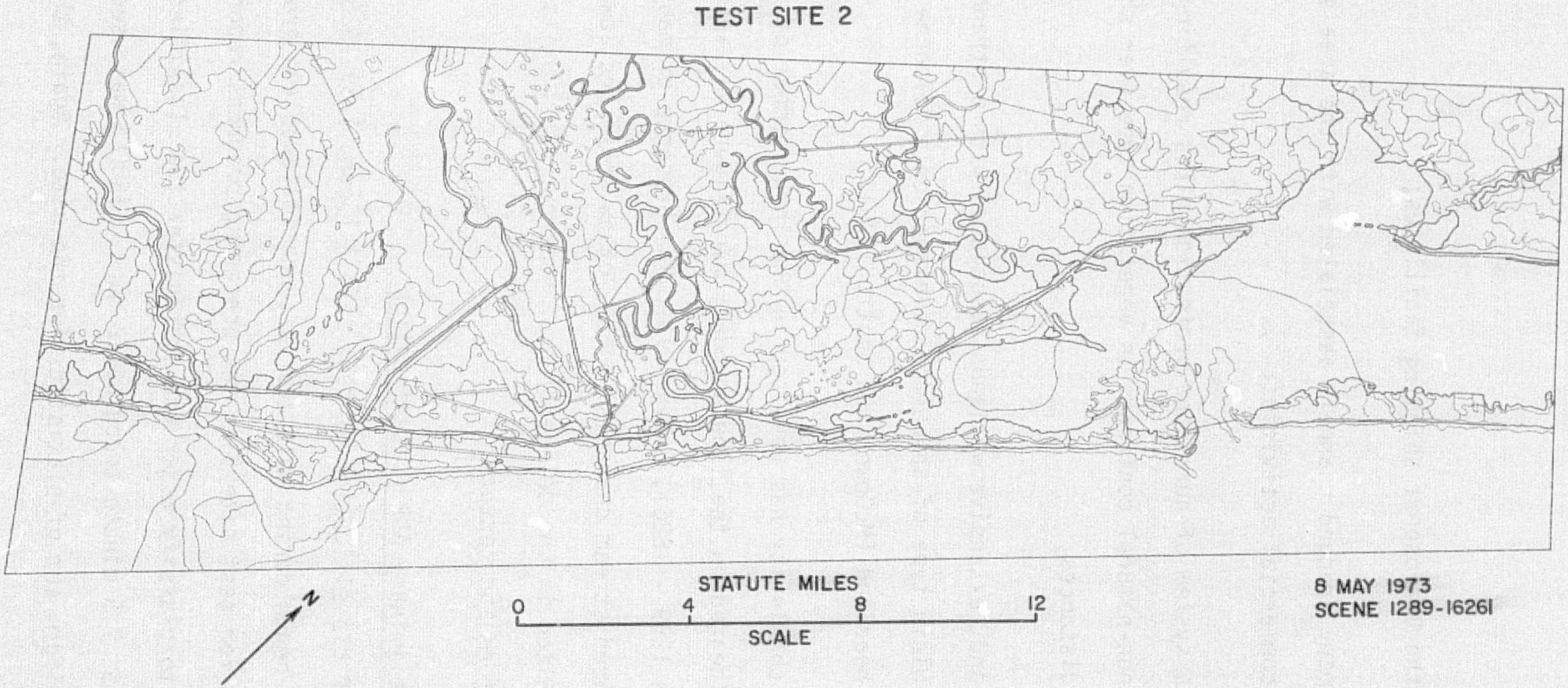

Figure 5. A line boundary map of site 2 showing the complex active and abandoned drainage patterns associated with this strandplain shoreline.

previously noted, that of small-member, scattered classes with large standard deviations, was encountered. ELLTAB was used to generate a preliminary classification of the area. Land features and water features were classified in separate runs when the combined look-up table exceeded the storage alloted to it. Registered classification maps are currently being produced for test site 2 that contain some areas of unclassified data. As soon as these difficulties with the poor statistics have been resolved, another classification at the site will be produced for correlation with the image interpretation results.

3.3 Interim Status of Monitoring System Design

3.3.1 Data Acquisition

The current status of LANDSAT data acquisition to support this investigation is reflected in Appendix C. The primary emphasis was placed on acquiring CCT's for sites 4 and 5 based on a review of the corresponding imagery which was previously ordered. In addition, all required imagery and tapes were ordered for LANDSAT scene 2375 - 16112, (1 February, 1976) covering site 2. This will provide a good winter scene of the site using the most current coverage which can be received within the time constraints of the project.

The "Suggested Purchase Package for LANDSAT Imagery Scenes" (Table 1) provides the necessary imagery to satisfy the imagery interpretation aspects of this investigation. In addition to

Table 1

Suggested Purchase Package For

LANDSAT Imagery Scenes

	Item	Scale	Band	Cost
1)	color transparency	1:1,000,000	composite	$12.00
2)	B & W print	1:250,000	5	15.00
			7	15.00
3)	B & W positive transparency	1:1,000,000	4	5.00
			5	5.00
			6	5.00
			7	5.00
4)	B & W negative transparency	1:1,000,000	5	6.00
			7	6.00

Cost if color master available $74.00

Additional cost of color master $50.00

Possible cost if color master needed $124.00

these requirements, the ADP classification effort requires the Computer Compatible Tapes (CCT) and a black-and-white positive transparency of Band 7 to support the Detection and Mapping (DAM) classification of land vs. water.

Experience gained from previous orders of LANDSAT materials placed with the EROS Data Center (EDC) indicate the following delivery schedules: Black and white imagery of the 4 bands and the CCT's require 4-6 weeks from the date of acquisition by the initial processing site (Goddard) for delivery of a "master" copy to EDC. Once these copies are available at EDC, it requires 2-3 weeks for production of black and white or color composite imagery products if the color composite "master" has already been produced. Production of the color "master" will require an additional 2-3 days. Delivery of the CCT's requires 7-10 days. Shipping time will probably add 2-3 days to each delivery. These time frames quoted above are generally maximums and in most cases delivery will be made in less time.

3.3.2 Interim Status of ADP and Image Interpretation Techniques

A revision of the ADP classification schedule presented in the last quarterly report is included in Table 2. Except for some changes in the parameters used in step 9 for developing class statistics using ISOCLS, only minor revisions in the ADP Classification schedule are anticipated during the next quarter.

Table 2

LANDSAT ADP Classification Schedule

Scene ID:

Test Site:

Description:

1. Select LANDSAT scene and determine data tapes ID number.
2. Examine available imagery.
3. Estimate scan line and sample numbers for the areas of interest.
4. Merge data tapes if necessary.
5. Generate grayscale maps of the area. (GRAYMAP)
6. Obtain meteorological data (precip, wind, tides).
7. Locate control points for the scene for registration and scaling.
8. Classify water using DAM.
9. Cluster all training areas within the scene (ISOCLS).
10. Examine class statistics.
11. Refine a training class if indicated by step 10.
12. Use class statistics to build the look-up table (ELLTAB).
13. Classify the area (ELLTAB).
14. Register and display the classified results (REGISTER).
15. Outline or color code homogeneous areas.
16. Examine the classification map.
17. Stop if satisfied with the results.
18. Retrain on unclassified or poorly separated areas (ISOCLS).
19. Go to step 12.

The techniques thus far developed for LANDSAT image interpretation at a 1:125,000 scale have formed the basis for the schedule of analysis of each scene outlined in Table 3. Note that a general acquaintance (steps 1 and 2) with the area is considered necessary before the line boundary delineation and area classification procedures are undertaken. Data review during step 1 is not as detailed as in step 5 during the verification procedure.

The accuracy evaluation procedure (step 8) will involve a qualitative analysis of the differences between LANDSAT image interpretations, ADP products and a third source of information. This latter will primarily be a combination of the NASA large scale aircraft photography of each test site and maps from the Environmental Geologic Coastal Atlas series (University of Texas, Bureau of Economic Geology, 1972-). Results will include a table of the types of differences between LANDSAT and larger scale data and the frequency with which they were encountered. The table will include each of the categories in the land use classification scheme for image interpretation.

3.3.3 Interim Display Products

At this time the products that we are considering to display the image interpretation and ADP classification efforts will be of two types:

1) Printer maps scaled and registered to USGS 7 1/2 minute topographic maps (1:24,000 scale) showing the ADP classification. These maps must be hand colored,

Table 3.

Schedule For Image Interpretation Analysis

1. Review aerial photography, Coastal Atlas Maps, and published tide and weather data for test site and image date.

2. Take a preliminary field trip to become generally acquainted with test site (may include oblique aerial photography).

3. Complete line boundary map of test site area.

4. Classify features delineated according to the modified Anderson system.

5. Study supportive data in detail, review results, field check and correlate with biological verification.

6. Document results for the scene, especially problems and unique aspects of the imagery.

7. Produce corrected image interpretation at 1:125,000 scale and overlays of selected quadrangles at 1:24,000 scale.

8. Qualitative analysis of the classification products to evaluate accuracy, utilizing aerial photography, Coastal Atlas maps and field results.

9. Evaluate format and content of resulting map.

10. Evaluate image interpretation of this scene in conjunction with other scenes for the same test site.

taped together, and trimmed to be used. In addition, the information on these maps must be further interpreted to make them completely compatible with the classification scheme that we have developed.

2) The image interpretation display product (1:125,000 scale) will be reproduced on a stable white plastic material, and hand colored to show the classification of all areas delineated on the line boundary map. For this product the interpretation will be based on the classification scheme.

Since this investigation does not contemplate generating a map series, these products or interim versions similar to these will be all that we will attempt.

The TNRIS however, is investigating alternative ways of generating hard copy color final products of ADP results, so that this service would be available to users of TNRIS. For example, TNRIS has requested that Seiscom Delta, of Houston, Texas, generate a color version of the Austwell classification developed in this investigation, and also submit a price list for different scales and volumes of products following this theme.

The products discussed above will be those compared to other information products of similar nature in the cost-savings analysis.

3.4 Program for the Next Reporting Interval

The following activities are planned for the next quarter:

1) Techniques developed for analyzing LANDSAT data will be applied to test site 5, and also at least one additional scene in test sites 2, 3, and 5, will be analyzed to determine the effect of seasonal and other changes in these scenes.

2) The optimum technique or mix of techniques for analysis of the LANDSAT data will be evaluated for use on the Texas coast.

3) Design of the LANDSAT-based monitoring system will be completed for testing during the summer.

4.0 SIGNIFICANT RESULTS

The most significant ADP result during this quarter was the modification of the DAM package to produce classified printouts, scaled and registered to U.S.G.S., 7 1/2 minute topographic maps from LARSYS-type classification files. With this modification, all the powerful scaling and registration capabilities of DAM become available for multi-class classification files such as those produced by LARSYS and ELLTAB (Section 3.1.2).

The most significant results with respect to image interpretation have been the application of the mapping techniques to a new, more complex area (test site 2), and the refinement of an image interpretation procedure which should yield the best results (Section 3.3.2).

5.0 PUBLICATIONS

The ADP classification of the Austwell quadrangle in site 3, generated by the procedure reported in this progress report, will be processed by Seiscom Delta, Inc. of Houston, Texas, during this next quarter. Seiscom Delta, Inc. will produce a sample color photographic product at a reduced scale and prepare a price list so that this option will be available to Texas agencies who plan to access the ADP classification procedure for LANDSAT data developed by this investigation through the Texas Natural Resources Information System (TNRIS).

6.0 RECOMMENDATIONS

None.

7.0 FUNDS EXPENDED

<u>GENERAL LAND OFFICE (GLO)</u>	
Labor	$ 6,909.00
Overhead	6.90
Travel	163.04
TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER	$ 7,078.94
<u>BUREAU OF ECONOMIC GEOLOGY (BEG)</u>	
Labor	$ 0
Materials & Supplies	0
Equipment	0
Travel	0
TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER	$ 0

TEXAS PARKS & WILDLIFE DEPARTMENT (TPWD)

Labor	$ 0
Materials & Supplies	0
Travel	0
TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER	$ 0

TEXAS WATER DEVELOPMENT BOARD (TWDB)

Labor	$ 2,822.00
Computer	400.00
TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER	$ 3,222.00

CONSULTING SERVICES

Dr. John A. Schell	$ 678.96
TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER	$ 678.96

CUMMULATIVE TOTAL EXPENDITURES REIMBURSED DURING THE 3rd QUARTER..............$10,979.90

8.0 DATA USE AS OF FEBRUARY 29, 1976

	IMAGERY Account #G23790 Amount	CCT Account #G B3790 Amount	AIRCRAFT Account #G W3790 Amount
Value of Data Allowed	$2,900.00	$5,400.00	$9,588.00
Value Ordered	$1,465.00	$2,000.00	$9,564.00
Value Received	$1,274.00	$ 600.00	$9,564.00
BALANCE	$1,435.00	$3,400.00	$ 24.00

9.0 AIRCRAFT DATA

The NASA aircraft photography has assumed greater importance with the development of the image interpretation sequence (Section 3.3.2, Table 3). It serves to familiarize the interpreter with the study area so that reasonable line boundaries can be drawn and classification decisions made. In an operational system the 1:120,000 photography of the entire Texas coastal zone (Mission 300, February, 1975) would fulfill this function. The NASA aerial photography also is being used in the verification procedure and will be the primary tool for analysis of classification and boundary accuracy as study of each scene is completed.

REFERENCES

Jones, R., Harwood, P., Finley, R., Murphy, D., and Holz, R. K., 1975, Development and Application of Operational Techniques for the Inventory and Monitoring of Resources and Uses in the Texas Coastal Zone: Type II (Quarterly) Report, September through November 1975, prepared for Goddard Space Flight Center, Greenbelt, Md. 20771, December 1975, Contract #NAS5-20986.

McGowen, J. H., and Scott, A. J., 1975, Hurricanes as Geologic Agents on the Texas Coast, in Estuarine Research, Vol. II, Geology and Engineering, Cronin, L. E., ed., Academic Press, New York.

McGowen, J. H., Proctor, C. V., Jr., Brown, L. F., Jr., Evans, T. J., Fisher, W. L., and Groat, C. G., 1972, Environmental Geologic Atlas of the Texas Coastal Zone--Port Lavaca Area: University of Texas, Bureau of Economic Geology, Austin.

Price, W. A., 1975, Physical Environmental Dynamics of Tidewater Zone, Texas and Human Interferences in Corpus Christi Area, unpublished notes, Coastal Science Workshop, Port Aransas, Tx. Sept. 25-27, 1975.

Texas Parks and Wildlife Department, 1975, Fishery Resources of The San Antonio Bay System, submitted to GLO Coastal Management Project, Contract #IAC(74-75)1472.

The Dallas Morning News, 1972. Texas Almanac and State Industrial Guide: Published and copyrighted by A. H. Belo Corp., Dallas.

University of Texas, Bureau of Economic Geology, 1972-, Environmental Geologic Atlas of the Texas Coastal Zone, 7 vols., Austin, L. F. Brown, Jr., Project Coordinator:

Brown, L. F., Jr., et al., Houston-Galveston Area. 1972.
Fisher, W. L., et al., Beaumont-Port Arthur Area. 1973.
McGowen, J. H., et al., Bay City-Freeport Area. in print.
Groat, C. G., et al., Brownsville-Harlingen Area. in print.
Brown, L. F., Jr., et al., Corpus Christi Area. in print.
Brown, L. F., Jr., et al., Kingsville Area. in print.
McGowen, J. H., et al., Port Lavaca Area. 1976.

APPENDIX A

SUBROUTINES MODIFIED IN DAM TO PRODUCE PRINTER MAPS SCALED AND REGISTERED TO U.S.G.S. 7 1/2 MINUTE TOPOGRAPHIC MAPS.

```
DB0200-02*SCALE.RDCLAS
      SUBROUTINE RDCLAS(ILDISK,ISDWLO,ISDWHI,NXWD)
C***THIS SUBROUTINE READS A LARSYS CLASSIFICATION FILE
C***AND RETURNS CLASSIFICATION RESULTS FOR LINE ILDISK
      DIMENSION NXWD(4000),IDATA(1000),NPTS(4),LSTART(4),LEND(4),
     *ISTART(4),IEND(4)
      DATA JUMP,NSAM/0,810/
      DEFINE XCCT(SDISK)=(SDISK+NSAM-1)/NSAM
      IF (JUMP.EQ.1) GO TO 10
      JUMP=1
      NCCTLO=MAX0(XCCT(ISDWLO-1),1)
      NCCTHI=MIN0(XCCT(ISDWHI+1),4)
C***READ HEADER RECORDS FROM LARSYS FILES
      DO 5 NCCT=NCCTLO,NCCTHI
      NUNIT=24+NCCT
      READ(NUNIT) NXWD(1)
      READ(NUNIT) NXWD(1)
      READ(NUNIT) NXWD(1)
      READ(NUNIT) NXWD(1)
      READ(NUNIT) (NXWD(I),I=1,10)
C***SAVE FIELD INFORMATION
      NPTS(NCCT)=NXWD(1)
      LSTART(NCCT)=NXWD(6)
      LEND(NCCT)=NXWD(7)
      ISTART(NCCT)=NXWD(9)
 5    IEND(NCCT)=NXWD(10)
C***FILL LINE WITH 'NO DATA' FLAGS
 10   DO 20 I=1,4000
 20   NXWD(I)='000000'
C***LOCATE REQUESTED DATA ON CLASSIFICATION FILES
      DO 50 NCCT=NCCTLO,NCCTHI
      NUNIT=24+NCCT
      IF (ILDISK.LT.LSTART(NCCT).OR.ILDISK.GT.LEND(NCCT)) GO TO 50
C***READ A CLASSIFIED LINE
      J=NPTS(NCCT)
 30   READ(NUNIT,END=50) ILINE,(IDATA(I),I=1,J)
      IF (ILINE.LT.ILDISK) GO TO 30
C***INSERT CLASSIFIED DATA INTO NXWD
      J=0
      KK=ISTART(NCCT)+NSAM*(NCCT-1)
      LL=IEND(NCCT)+NSAM*(NCCT-1)
      DO 40 I=KK,LL
      J=J+1
 40   NXWD(I)=IDATA(J)
 50   CONTINUE
      RETURN
C***REWIND FILES AND RESET JUMP FLAG
      ENTRY RESETJ
      JUMP=0
      DO 60 NCCT=NCCTLO,NCCTHI
      NUNIT=24+NCCT
 60   REWIND NUNIT
      RETURN
      END
```

```
DB0200-02*SCALE.MAPRNT
          SUBROUTINE MAPRNT(KERR)
      C (EHS)
      C THIS SUBROUTINE REGISTERS ERTS MSS DATA FOR
      C DAM.PRTCLASS.
      C
      C
      C THIS SUBROUTINE CALLS THE FOLLOWING EXTERNAL SUBROUTINES/FUNCTIONS:
      C       NITHDG
      C       SYMTAB
      C       TICGEN
      C       RDCLAS
      C
          INCLUDE KOMXOT,LIST
          INCLUDE KOMID,LIST
          INCLUDE KOMCTL,LIST
          INCLUDE KOMCCT,LIST
          INCLUDE KOMMAP,LIST
          INCLUDE KOMALT,LIST
          INCLUDE KOMSYM,LIST
          DATA IOUT/8/    @  OUTPUT TAPE OF CLASSIFIED DATA
          DIMENSION NXWD(4000)
          DIMENSION ISPSYM(1120)
          DIMENSION LINFMT(4)
          DATA LINFMT/'(1X,I1,1X,J4,NNNA1,J4)'/
          DATA JDOLAR/'$'/
          INCLUDE TAPCOR,LIST      @ DEFINE PROCEDURES FOR TAPE CORRECTION
          INCLUDE NITAB,LIST     @ DEFINE PROCEDURE TO COMPUTE ALT PRINT UNIT NUMBERS
          INCLUDE DIGITS,LIST      @ DEFINE PROCEDURES FOR DIGIT EXTRACTION
      C
      C
      C GENERATE TABULAR DATA
      C
          NITLO=0
          NITHI=0
          INCLUDE NITROT,LIST
          NIT=0
          NUNIT=NTAB(NIT)
          CALL NITHDG(NIT,NUNIT)
          CALL SYMTAB(NIT,NUNIT)
          CALL TICGEN(KERR,NIT,NUNIT)
      C
      C
      C INITIALIZE WINDOW
      C
          ILPWIN=WLPMIN
          ILPWAX=WLPMAX
          ISPWIN=WSPMIN
          ISPWAX=WSPMAX
          ILPTIC=0
          ISPTIC=0
          LVLTIC='
      C
      C
      C BREAK WINDOW INTO SUB-WINDOWS
      C
          ISPMOD=MOD((ISPWAX-ISPWIN),124)+1
```

```
      ENDFILE IOUT
      CALL RESETJ
      RETURN
C
C
C
C
C
C
C
      SUBROUTINE GETIC
      NTICK=NTICK+1
      ILPTIC=FLD(00,18,LOCTIC(NTICK))
      ISPTIC=FLD(18,12,LOCTIC(NTICK))
      FLD(0,6,LVLTIC)=FLD(30,06,LOCTIC(NTICK))
      RETURN
C
C
C
C
C
C
      SUBROUTINE SAMSCL
   99 FORMAT(7X,124I1)
      ISPNLO=ISPWLO
      DO 998 NIT=NITLO,NITHI
      NUNIT=NTAB(NIT)
      ISPNHI=MIN0((ISPNLO+123),ISPWHI)
      DO 1000 I=ISPNLO,ISPNHI
 1000 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=I/1000
      WRITE(NUNIT,99) (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI)
      DO 100 I=ISPNLO,ISPNHI
  100 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=(I-1000*(I/1000))/100
      WRITE(NUNIT,99) (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI)
      DO 10 I=ISPNLO,ISPNHI
   10 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=(I-100*(I/100))/10
      WRITE(NUNIT,99) (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI)
      DO 1 I=ISPNLO,ISPNHI
    1 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=I-10*(I/10)
      WRITE(NUNIT,99) (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI)
  998 ISPNLO=ISPNHI+1
      DO 999 I=ISPWLO,ISPWHI
  999 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=0
      RETURN
C
C
C
C
C
C
      SUBROUTINE LINOUT
C
C LOOK UP COUNT SYMBOLS
C
      WRITE(IOUT) (ISPSYM(I-ISPWIN+1),I=ISPWLO,ISPWHI)
      DO 150 I=ISPWLO,ISPWHI
      ISPCNT=MIN0(ISPSYM(I-ISPWIN+1),(KSYMSZ-1))
```

```
      C
      C
      C SCAN DENSITY PIXELS
      C
        320 ISDISK=ISDISK+1
            NWD=NWD+1
        325 IF(ISDISK.GT.ISDWHI) GO TO 400
            GO TO 310
      C
      C
      C REGISTER FIRST 'NO DATA' PIXEL
      C
        350 ASCOR=XASCOR(FLOAT(ISDISK))
            ISP1=CP(4)*ALCOR+CP(5)*ASCOR+CP(6)
            IF(ISDISK.GT.0) GO TO 360
            ISDISK=1
            NWD=1
      C
      C
      C SCAN 'NO DATA' PIXELS
      C
        360 ISDISK=ISDISK+1
            NWD=NWD+1
        365 IF(ISDISK.GT.ISDWHI) GO TO 380
            IF (NXWD(NWD).NE.'000000') GO TO 380
            GO TO 360
      C
      C
      C REGISTER STRING OF 'NO DATA' PIXELS
      C
        380 ASCOR=XASCOR(FLOAT(ISDISK-1))      @ LAST 'NO DATA' PIXEL
            ISP2=CP(4)*ALCOR+CP(5)*ASCOR+CP(6)
            DO 385 ISPRNT=ISP1,ISP2
        385 IF (ISPRNT-ISPWIN+1.GT.0) ISPSYM(ISPRNT-ISPWIN+1)=+999999
            IF(ISDISK.GT.ISDWHI) GO TO 400
            GO TO 310
      C
      C
      C INCREMENT DISK LINE AND WRITE PRINT LINE
      C
        400 ILDISK=ILDISK+1
            ALCOR=ILDISK      @FUTURE CORRECTION
            NLPRNT=CP(1)*ALCOR+CP(3)
            IF(NLPRNT.GT.ILPRNT) CALL LINOUT
            IF(NLPRNT.GT.ILPWAX) GO TO 500
            GO TO 200
      C
      C
      C FOOT SUB-WINDOWS
      C
        500 CALL SAMSCL
      C
      C
        800 CONTINUE
            WRITE(HUNIT,805)
        805 FORMAT('0'/6X,' **SEE UNIT 0 FOR LEGEND**')
      C
```

```
      FLD(06,6,LINFMT(3))=FLD(00,6,JHUNS(ISPMOD))
      FLD(12,6,LINFMT(3))=FLD(00,6,JTENS(ISPMOD))
      FLD(18,6,LINFMT(3))=FLD(00,6,JONES(ISPMOD))
      DO 800 NITLO=1,NITMAX,MALTM
      NITHI=MIN0((NITLO+MALTM-1),NITMAX)
      INCLUDE NITROT,LIST
      ALCOR=PC(1)*ILPWIN+PC(3)
      ILDISK=ALCOR       @ FUTURE CORRECTION
      ALCOR=ILDISK       @ FUTURE CORRECTION
      ILPRNT=CP(1)*ALCOR+CP(3)
      ISPWLO=ISPWIN+124*(NITLO-1)
      ISPWHI=MIN0((ISPWIN+124*NITHI-1),ISPWAX)
      NTICK=0
      CALL GETIC
C
C
C HEAD SUB-WINDOWS
C
      DO 140 NIT=NITLO,NITHI
      NUNIT=NTAB(NIT)
      CALL NITHDG(NIT,NUNIT)
  140 CONTINUE
      CALL SAMSCL
C
C
C COMPUTE FIRST/LAST DENSITY SAMPLES
C
  200 ASCOR=PC(4)*ILPRNT+PC(5)*ISPWLO+PC(6)
      ISDWLO=XASDSK(ASCOR)
      ASCOR=PC(4)*ILPRNT+PC(5)*(ISPWHI+1)+PC(6)
      ISDWHI=XASDSK(ASCOR)+1.0
C
C
C READ DENSITY LINE
C
      CALL RDCLAS(ILDISK,ISDWLO,ISDWHI,NXWD)
C
C
C LOCATE FIRST DENSITY PIXEL
C
      ISDISK=ISDWLO
      NWDLO=ISDWLO
      NWD=NWDLO
      NWDHI=ISDWHI
      IF(ISDISK.LT.1) GO TO 350
C
C
C SCREEN PIXEL DENSITY
C
  310 IF (NXWD(NWD).EQ.'000000') GO TO 350
C
C
C REGISTER/COUNT SCREENED PIXELS
C
      ASCOR=XASCOR(FLOAT(ISDISK))
      ISPRNT=CP(4)*ALCOR+CP(5)*ASCOR+CP(6)
      IF (ISPRNT-ISPWIN+1.GT.0) ISPSYM(ISPRNT-ISPWIN+1)=NXWD(NWD)
```

```
      150 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=KSYM(ISPCNT+1)
          GO TO 300
C
C
C BLANK OUT LINE SKIPPED FOR SCALING
C
      200 DO 250 I=ISPWLO,ISPWHI
      250 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=' '
C
C
C INSERT TICK MARKS
C
      300 IF(ILPTIC.GT.ILPRNT) GO TO 400
          IF(ISPSYM(ISPTIC-ISPWIN+1).EQ.' ') GO TO 330
          IF(ISPSYM(ISPTIC-ISPWIN+1).NE.':') GO TO 350
          IF(ISPSYM(ISPTIC-ISPWIN).EQ.':')
         1   ISPSYM(ISPTIC-ISPWIN)=' '
          IF(ISPSYM(ISPTIC-ISPWIN+2).EQ.':')
         1   ISPSYM(ISPTIC-ISPWIN+2)=' '
      330 IF (ISPTIC-ISPWIN+1.GT.0) ISPSYM(ISPTIC-ISPWIN+1)=LVLTIC
      350 CALL GETIC
          GO TO 300
      400 CONTINUE
C
C
C WRITE SUB-WINDOW PRINT LINE
C
          ISPNLO=ISPWLO
          DO 540 NIT=NITLO,NITHI
          NUNIT=NTAB(NIT)
          ISPNHI=MIN0((ISPNLO+123),ISPWHI)
          IF((NIT.EQ.NITMAX).AND.(ISPMOD.LT.122)) GO TO 530
          WRITE(NUNIT,520) NIT,ILPRNT,
         1 (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI),JDOLAR
      520 FORMAT(1X,I1,1X,J4,125A1)
          GO TO 540
      530 WRITE(NUNIT,LINFMT) NIT,ILPRNT,
         1 (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI),ILPRNT
      540 ISPNLO=ISPNHI+1
          IF(KSYBIT.EQ.0) GO TO 700
C
C
C OVERPRINT SYMBOLS
C
          DO 660 KBIT=06,KSYBIT,6
          DO 610 I=ISPWLO,ISPWHI
  610     IF (I-ISPWIN+1.GT.0)
         1 FLD(00,6,ISPSYM(I-ISPWIN+1))=FLD(KBIT,6,ISPSYM(I-ISPWIN+1))
          ISPNLO=ISPWLO
          DO 640 NIT=NITLO,NITHI
          NUNIT=NTAB(NIT)
          ISPNHI=MIN0((ISPNLO+123),ISPWHI)
          WRITE(NUNIT,620)
         1 (ISPSYM(I-ISPWIN+1),I=ISPNLO,ISPNHI)
      620 FORMAT('+',6X,124A1)
      640 ISPNLO=ISPNHI+1
      660 CONTINUE
```

```
C
C
C INCREMENT PRINT LINE
C
  700 ILPRNT=ILPRNT+1
      IF(NLPRNT.GT.ILPRNT) GO TO 200
C
C
C REINITIALIZE LINE
C
      DO 750 I=ISPWLO,ISPWHI
  750 IF (I-ISPWIN+1.GT.0) ISPSYM(I-ISPWIN+1)=0
      RETURN
      END
```

@PRT,S SCALE.RDCLAS

APPENDIX B

VEGETATION SAMPLING FOR LANDSAT DATA

Vegetation Sampling for LANDSAT Data

prepared by Larry Lodwick
Texas Parks and Wildlife Department

INTRODUCTION

In an effort to obtain quantitative ground data on the plant communities as defined by LANDSAT Telemetry, a sampling system which will allow a quick, yet quantitative analysis of the communities needs to be developed. The procedure should be adaptable to the various communities present, from mud flats, with only sparse vegetation cover to salt marshes, being predominately grasses or grass-like plants, to woodlands.

The most efficient sampling system for large areas would be the point intercept measurement of cover. This has several advantages in that 1) it gives an indication of biomass (especially if height of the vegetation is known); 2) it can be used for all growth forms, from bryophytes to tree canopies; and 3) it can be adapted for the size of the community to be sampled (i.e., points farther apart for larger vegetation types). Although widely spaced points tend to reduce the precision of the measurements, it does serve as more rapid measurement than other sampling techniques (Mueller-Dombois and Ellenberg, 1974).

From the data obtained by the cover method, it is possible to designate plant associations which could be related to the various images interpreted by LANDSAT.

MATERIALS AND METHODS

An advantage to sampling cover as opposed to other parameters is the small amount of equipment required for field sampling. The required materials consist of a tape measure with a minimum length of 25 meters (or 25 yards), a meter (or yard) stick, tally sheets (figure 1) for the sampling data and a plant press for collecting those plants which the investigator is unfamiliar with.

The method for data collection is as follows:

1) Prior to going into the field the sampling site should be located using the LANDSAT printout to determine the approximate center of the vegetation type to be sampled. This point should then be located on a topographic map (U.S.G.S.) or low altitude photograph.

2) Using the topographic map or photograph, locate the sampling site on the ground, setting a stake at the center point. The tape measure should then be extended first to the north, then south, east, and west of the center point (preferably with the use of a compass) to a distance of 25 meters or yards (figure 2). The purpose of determining the location and direction of the transects prior to beginning of sampling is to reduce the bias of the investigator.

3) At 25 evenly spaced points in each of the four directions from the center point, preferably at 1 meter (or yard) intervals, all species directly above or below the points should be identified and its height, measured with the meter (or yard) stick (which, in the case of trees, may be estimated), recorded on the tally sheet (figure 3 and 3a). Bare soil, without vegetation, should also be recorded and treated as a species. This will enable one to assess the bare ground (mud flats, dredge spoil, etc.). Those plant species in which the investigator is unfamiliar should be collected, pressed, and sent in for identification. Preferably the collection should consist of two or three individuals pressed separately with flowers (or fruits) and roots. These should be pressed. ~~according to the instructions in appendix A.~~ Information as to the sampling site, soil type, soil wetness (tidal marsh, dry uplands, standing water, etc.) should be recorded. The unknown plants should be numbered and the number listed on the tally sheet in place of the name. After the plant is identified, the number should be replaced by the correct name.

4) The information on the tally sheet should include the name of the investigator, to the transect line number (as related to the map), the bearing of the line (north, south, east, or west), the date, and the amount of inundation at the time of the sampling (i.e., dry land, mud, standing water, etc.).

5) One copy of each field sheet should then be sent to Austin for evaluation and analysis of the plant associations.

6) After several sites have been investigated, any problems encountered need to be discussed to determine what changes in the procedures might be made to alleviate the problems.

Reference

Mueller-Dombois, Dieter, and Ellenberg, Heinz, 1974, Aims and Methods of Vegetation Ecology: John Wiley and Sons, New York, 547 p.

VEGETATION SURVEY

Investigator ____________ Date ____________ Line ____________ Bearing ____________

Level of Inundation ____

Sampling Points

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	

Figure 1. Sample tally sheet for recording ground cover.

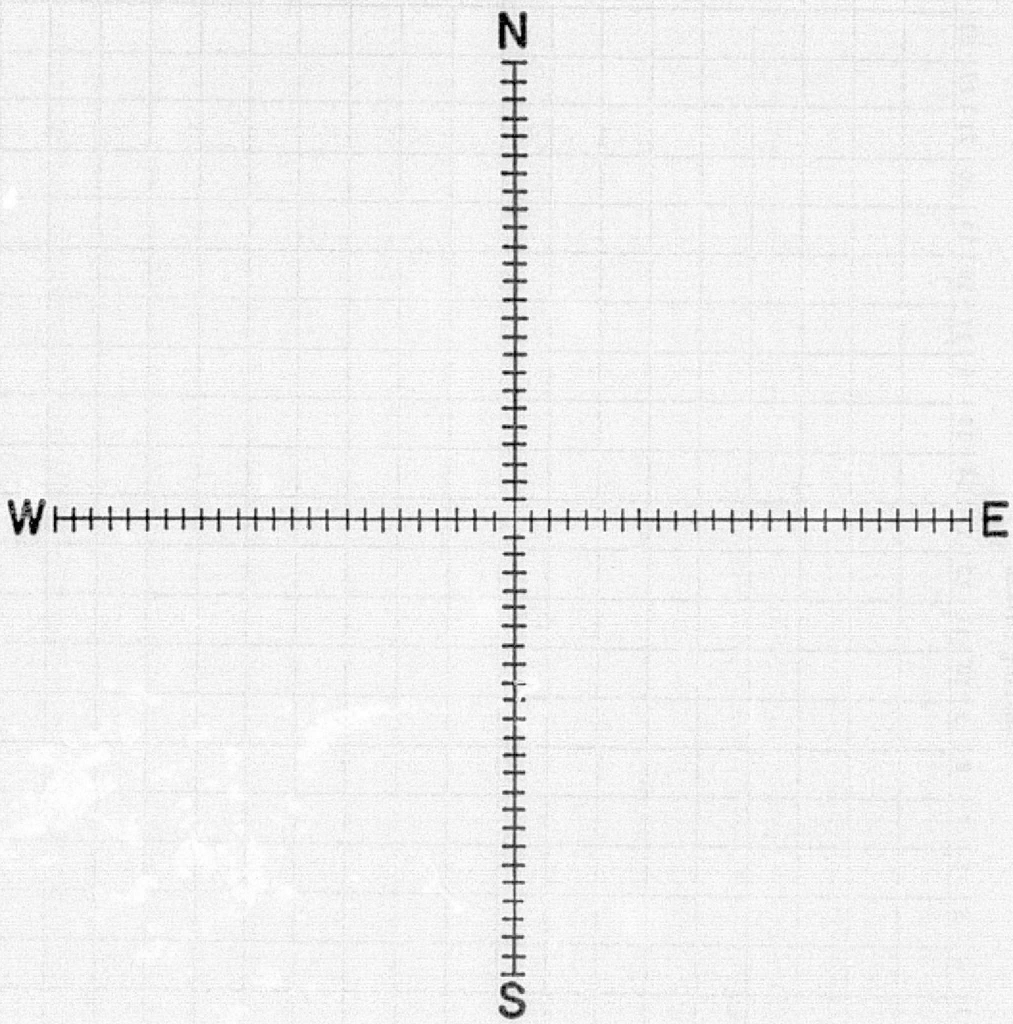

Figure 2. Sample area for the measure of the point intercept method. After reaching a predetermined sampling site, select the center point and with the use of a compass, record those species which occur at 25 regular intervals (preferably one meter intervals) directly north, south, east, and west of the center point.

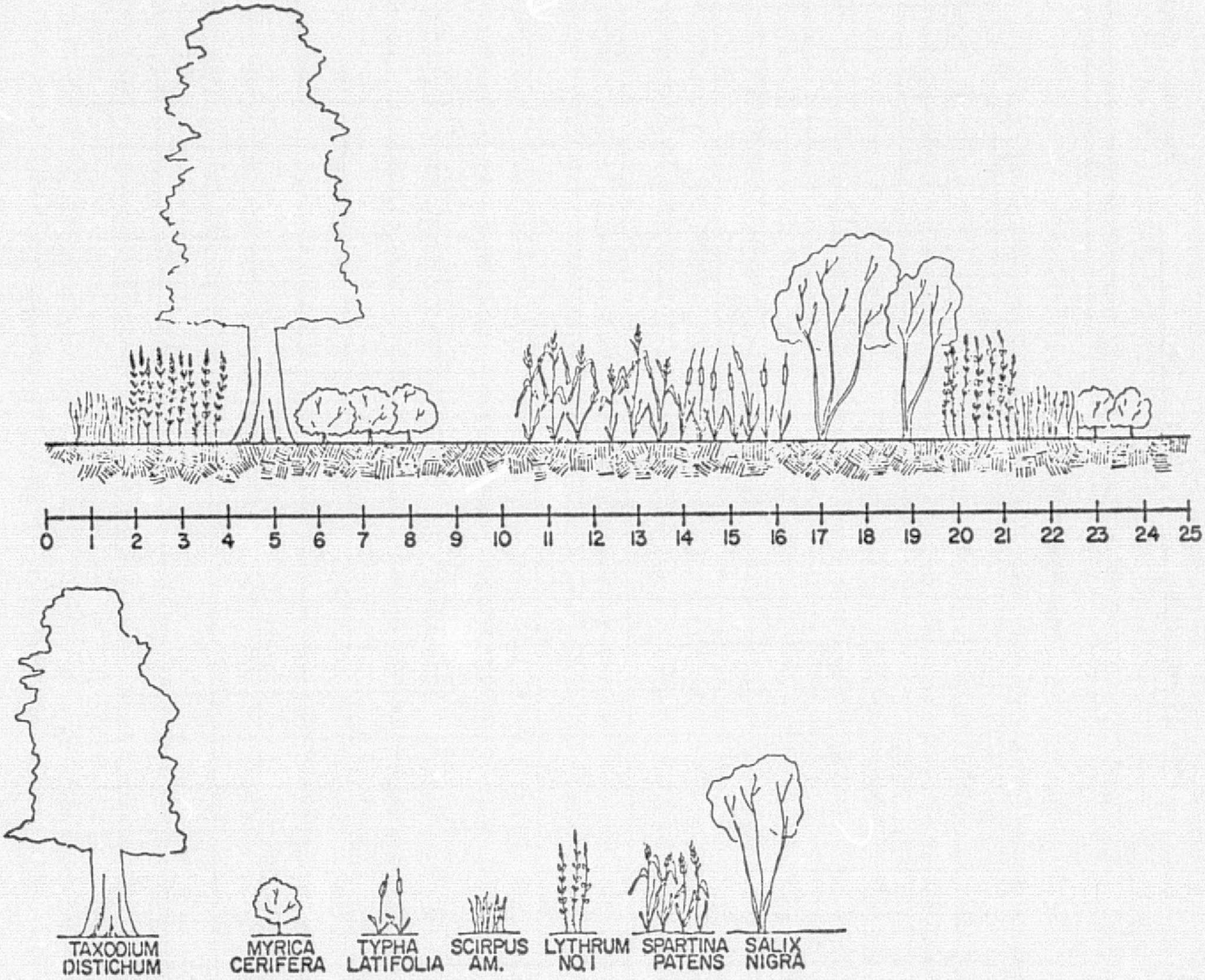

Figure 3. A schematic representation of a wetland vegetation type containing seven species.

VEGETATION SURVEY

Investigator L. Lodwick Date 14 Jan. 1976 Line 001 Bearing North

Level of Inundation Dry ground

Sampling Points

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	# of pts.
Scirpus americana	1m																					0.9m				2
Lythrum sp. #1		2m	2m																	2m	2m					4
Taxodium distichum			9.5m	9.5m	9.5m	9.5m																				4
Myrica cerifera						1.2m	1.2m	1.2m															1m	1m		5
Spartina patens											2m	2m	2m													3
Typha latifolia														2m	2m	2m										3
Salix nigra																4.5m	4.5m	4m	4m	4m						5
Exposed soil									X	X															X	3

Figure 3a. A tally sheet with the data for the association shown in Figure 3.

30-15

APPENDIX C

LANDSAT COVERAGE OF THE TEST SITES 2, 3, 4, 5 FOR LANDSAT INVESTIGATION #23790

APPENDIX C

LANDSAT COVERAGE OF THE TEST SITES 2, 3, 4, 5

FOR LANDSAT INVESTIGATION #23790

ACQUISITION STATUS	SCENE ID	DATE	CLOUD COVER	QUALITY
	Test Site 2:			
	Summer: June - August			
2	1037 - 16251	08/29/72	20%	8888
	1343 - 16253	07/01/73	20%	8888
	1361 - 16252	07/19/73	20%	8888
2, 4	1703 - 16175	06/26/74	10%	8858
	Fall: Sept. - Nov.			
2	1073 - 16251	10/04/72	30%	8888
	Winter: Dec. - Feb.			
2	1217 - 16261	02/25/73	20%	8888
2	1505 - 16230	12/10/73	00%	2822
1	1901 - 16110	01/10/75	10%	8808
1, 3	2375 - 16112	02/01/76	00%	
2	1576 - 16152	02/19/74	00%	8888
	Spring: Mar. - May			
	1253 - 16262	04/02/73	20%	8888
2, 4	1289 - 16261	05/08/73	00%	8888
2	2051 - 16140	03/14/75	00%	8855
2	5027 - 16050	05/16/75	10%	5588

ACQUISITION STATUS	SCENE ID	DATE	CLOUD COVER	QUALITY
	Test Site 3:			
	Summer: June - Aug.			
	1343 - 16253	07/01/73	20%	8888
	1361 - 16252	07/19/73	20%	8888
	1038 - 16305	08/30/72	20%	8888
	1362 - 16305	08/30/72	20%	8888
2, 4	1703 - 16175	06/26/74	10%	8858
	Fall: Sept. - Nov.			
	1092 - 16312	10/23/72	20%	8888
	1110 - 16313	11/10/72	00%	8888
	1452 - 16291	10/18/73	00%	7828
	Winter: Dec. - Feb.			
2, 4	1146 - 16314	12/16/72	00%	8888
	1164 - 16312	01/03/73	10%	8888
	1182 - 16313	01/21/73	00%	8888
2, 4	2034 - 16200	02/25/75	00%	8888
	2016 - 16200	02/07/75	10%	5888
2	1578 - 16264	02/21/74	10%	8282
	Spring: Mar. - May			
	1253 - 16262	04/02/73	20%	8888
	1289 - 16261	05/08/73	00%	8888
	1236 - 16320	03/16/73	10%	8888
	1290 - 16315	05/09/73	00%	8888
	1308 - 16314	05/27/73	20%	8888
2, 4	1614 - 16261	03/29/74	10%	8888

ACQUISITION STATUS	SCENE ID	DATE	CLOUD COVER	QUALITY
2, 4	1614 - 16261	03/29/74	10%	8888
	1974 - 16133	03/24/75	00%	8858
2	5028 - 16104	05/17/75	10%	8885
	Test Site 4:			
	Summer: June - Aug.			
2	1326 - 16315	06/14/73	10%	8888
2	1740 - 16225	08/02/74	20%	8888
	1758 - 16221	08/20/74	20%	8888
2, 3	5082 - 16080	07/10/75	10%	8888
	Fall: Sept. - Nov.			
2	1092 - 16314	10/23/72	10%	8888
	1110 - 16320	11/10/72	10%	8888
	1452 - 16293	10/18/73	10%	8828
	Winter: Dec. - Feb.			
2, 4	1146 - 16320	12/16/72	20%	8888
	1164 - 16315	01/03/73	20%	8888
2, 3	1182 - 16315	01/21/73	00%	8888
	2016 - 16202	02/07/75	00%	5885
2, 3	2034 - 16202	02/25/75	00%	8888
	Spring: Mar. - May			
	1236 - 16323	03/16/73	20%	8888
	1254 - 16323	04/03/73	10%	8888
	1290 - 16321	05/09/73	20%	8888

ACQUISITION STATUS	SCENE ID	DATE	CLOUD COVER	QUALITY
2	1308 - 16320	05/27/73	10%	8888
2	1974 - 16135	03/24/75	10%	8858
	5028 - 16111	05/17/75	10%	5588
	Test Site 5:			
	Summer: June - Aug.			
	1362 - 16315	07/20/73	20%	8888
	1380 - 16314	08/07/73	20%	8888
	1722 - 16235	07/15/74	20%	8888
2, 3	1740 - 16231	08/02/74	10%	8888
2	1758 - 16223	08/20/74	10%	8888
	Fall: Sept. - Nov.			
2	1110 - 16322	11/10/72	10%	8888
2	1776 - 16215	09/07/74	20%	5855
	Winter: Dec. - Feb.			
2, 3	1182 - 16322	01/21/73	00%	8888
	1506 - 16293	12/11/73	10%	8888
2, 3	2034 - 16205	02/25/75	00%	8888
		10/18/73	20%	8888
	Spring: Mar. - May			
	1614 - 16270	03/29/74	20%	8888
	1974 - 16142	03/24/75	10%	8888
	2070 - 16203	04/02/75	20%	8588
2	1290 - 16324	05/09/73	20%	8888

ACQUISITION STATUS

1 Imagery on Order

2 Imagery on Hand

3 Tapes on Order

4 Tapes on Hand